
Substrate elasticity regulates skeletal muscle stem cell self-renewal in culture.

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Public Summary:

Stem cells that naturally reside in adult tissues, such as muscle stem cells (MuSCs), exhibit robust regenerative capacity in vivo that is rapidly lost in culture. Using a bioengineered substrate to recapitulate key biophysical and biochemical niche features in conjunction with a highly automated single-cell tracking algorithm, we show that substrate elasticity is a potent regulator of MuSC fate in culture. Unlike MuSCs on rigid plastic dishes (approximately 10(6) kilopascals), MuSCs cultured on soft hydrogel substrates that mimic the elasticity of muscle (12 kilopascals) self-renew in vitro and contribute extensively to muscle regeneration when subsequently transplanted into mice and assayed histologically and quantitatively by noninvasive bioluminescence imaging. Our studies provide novel evidence that by recapitulating physiological tissue rigidity, propagation of adult muscle stem cells is possible, enabling future cell-based therapies for muscle-wasting diseases.

Scientific Abstract:

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